CLAIMS

What is claimed is:

1. A method for manufacturing high-quality Mn-doped nanocrystals, the method comprising the steps of:

(a) combining an organometallic manganese precursor with an organometallic Group II precursor and an organometallic Group VI precursor to provide a precursor mixture;

(b) diluting the precursor mixture with a dilution solvent to provide an injection mixture;

(c) heating a coordinating solvent;

(d) stirring the heated coordinating solvent; and

(e) injecting the injection mixture into the heated coordinating solvent while the heated coordinating solvent is being stirred.

2. The method of Claim 1, wherein the organometallic manganese precursor is selected from the group consisting of dimethylmanganese, $Mn(CO)_5Me$, $[MnTe(CO)_3(PEt_3)_2]_2$, and $Mn_2(\mu\text{-}SeMe)_2(CO)_8$.

3. The method of Claim 1, wherein the organometallic Group II precursor is selected from the group consisting of dialkylzinc, dialkylcadmium and dialkylmercury.

4. The method of Claim 1, wherein the organometallic Group II precursor is selected from the group consisting of diethylzinc, dimethylcadmium and dibenzylmercury.

5. The method of Claim 1, wherein the organometallic Group VI precursor is selected from the group consisting of trialkylphosphine selenide and trialkylphosphine telluride.

6. The method of Claim 1, wherein the organometallic Group VI precursor is selected from the group consisting of trioctylphosphine selenide, [bis(trimethylsilyl)sulfide] and trioctylphosphine telluride.

7. The method of Claim 1, wherein the dilution solvent is trialkylphosphine .

8. The method of Claim 1, wherein the dilution solvent is selected from the group consisting of trioctylphosphine and tributylphosphine.

9. The method of Claim 1, wherein the coordinating solvent is hexadecylamine.

10. The method of Claim 1, wherein the coordinating solvent is heated in step (c) to a temperature that is sufficient to at least substantially eliminate defects in nanocrystals produced after the injection mixture is injected into the heated coordinating solvent

11. The method of Claim 1, wherein the coordinating solvent is heated in step (c) to a temperature of at least 200°C.

12. The method of Claim 1, wherein the coordinating solvent is heated in step (c) to a temperature of at least 300°C.

13. The method of Claim 1, further comprising the step of combining $MnCl_2$ in tetrahydrofuran with methylmagnesium chloride in tetrahydrofuran to provide dimethylmanganese as the organometallic manganese precursor for step (a).

14. The method of Claim 1, wherein the step (e) of injecting the injection mixture into the heated coordinating solvent while the heated coordinating solvent is being stirred provides a reaction mixture, the method further comprising the step of:

(f) heating the reaction mixture at a temperature of at least 250°C such that the size of the nanocrystals increases.

15. The method of Claim 14, further comprising the step of:

(g) removing the heat applied in step (f) from the reaction mixture such that nanocrystals of a predetermined size are provided.

16. The method of Claim 1, wherein the step (e) of injecting the injection mixture into the heated coordinating solvent while the heated coordinating solvent is being stirred provides a reaction mixture, the method further comprising the step of:

(f) isolating the nanocrystals from the reaction mixture by precipitation.

17. The method of Claim 1, wherein the step (e) of injecting the injection mixture into the heated coordinating solvent while the heated coordinating solvent is being stirred provides a reaction mixture, the method further comprising the step of:

(f) isolating the nanocrystals from the reaction mixture by size-selective precipitation such that the size distribution of the nanocrystals is improved.

18. The method of Claim 1, further comprising the step of:

(f) dispersing the nanocrystals into a host material.

19. The method of Claim 1, further comprising the step of:

(f) coating the surface of the nanocrystals with a material such that properties of the nanocrystals are altered.

20. High-quality Mn-doped nanocrystals manufactured according to the method of Claim 1.

21. A method for manufacturing high-quality Mn-doped ZnSe nanocrystals, the method comprising the steps of:

(a) combining dimethylmanganese with diethylzinc and trioctylphosphine selenide to provide a precursor mixture;

(b) diluting the precursor mixture with trioctylphosphine to provide an injection mixture;

(c) heating hexadecylamine;

(d) stirring the heated hexadecylamine; and

(e) injecting the injection mixture into the heated hexadecylamine while the heated hexadecylamine is being stirred.

22. The method of Claim 21, wherein the hexadecylamine is heated in step (c) to a temperature of at least 300°C.

23. The method of Claim 21, further comprising the step of combining $MnCl_2$ in tetrahydrofuran with methylmagnesium chloride in tetrahydrofuran to provide the dimethylmanganese for step (a).

24. High-quality Mn-doped ZnSe nanocrystals manufactured according to the method of Claim 21.

25. A method for manufacturing high-quality Mn-doped ZnS nanocrystals, the method comprising the steps of:

(a) combining dimethylmanganese with diethylzinc and [bis(trimethylsilyl)sulfide] to provide a precursor mixture;

(b) diluting the precursor mixture with trioctylphosphine to provide an injection mixture;

(c) heating hexadecylamine;

(d) stirring the heated hexadecylamine; and

(e) injecting the injection mixture into the heated hexadecylamine while the heated hexadecylamine is being stirred.

26. The method of Claim 25, wherein the hexadecylamine is heated in step (c) to a temperature of at least 300°C.

27. The method of Claim 25, further comprising the step of combining $MnCl_2$ in tetrahydrofuran with methylmagnesium chloride in tetrahydrofuran to provide the dimethylmanganese for step (a).

28. High-quality Mn-doped ZnS nanocrystals manufactured according to the method of Claim 25.

29. A method for manufacturing high-quality Mn-doped ZnTe nanocrystals, the method comprising the steps of:

(a) combining dimethylmanganese with diethylzinc and trioctylphosphine telluride to provide a precursor mixture;

(b) diluting the precursor mixture with trioctylphosphine to provide an injection mixture;

(c) heating hexadecylamine;

(d) stirring the heated hexadecylamine; and

(e) injecting the injection mixture into the heated hexadecylamine while the heated hexadecylamine is being stirred.

30. The method of Claim 29, wherein the hexadecylamine is heated in step (c) to a temperature of at least 300°C.

31. The method of Claim 29, further comprising the step of combining $MnCl_2$ in tetrahydrofuran with methylmagnesium chloride in tetrahydrofuran to provide the dimethylmanganese for step (a).

32. High-quality Mn-doped ZnTe nanocrystals manufactured according to the method of Claim 29.